

Deep Learning Capstone Project: Computer Vision and Malaria

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The context: Why is this problem important to solve?

Malaria is one of the world's most infectious diseases. Traditional diagnosis procedures are tedious and time consuming, requiring experienced professionals. Inaccuracies caused by human error adversely impact diagnosis. An automated system to help with early and accurate detection of malaria can save more lives with better accuracy than manual diagnosis.

The objectives: What is the intended goal?

The objective of this project is to build an efficient computer vision model to detect malaria. The model will identify an image of a red blood cell and determine where it is infected with malaria or not. The red blood cells will be classified as parasitized or uninfected.

Potential techniques - What different techniques should be explored?

Overall solution design - What is the potential solution design?

We will train a convolutional neural network (CNN) to recognize and predict the presence of parasites in cell images to determine a Malaria diagnosis. A CNN is a better option than a traditional Artificial Neural Network (ANN) when it comes to image data such as the red blood cell dataset provided. Since each pixel in the image is considered a node in the NN and each node is connected with each other in a feed-forward NN, we get a lot of parameters to train which makes it computationally expensive. The main benefits of CNN's are local spatiality and weight sharing. A CNN's convolution layer places a filter over the entire image, allowing it to detect local features (local spatiality) in the image such as an edge or curve. The filter slides over the whole image resulting in weights of the filter being shared between all patches of the image aka weight sharing. This is beneficial as it results in each convolution filter layer requiring a smaller number of weights to process, thereby reducing time and cost for training the NN. Weight sharing is a form of regularization and results in the feature search insensitive to feature location in the image. Each filter becomes a 'one particular information' detector.

Measures of success - What are the key measures of success to compare potential techniques?

We will determine the performance of the CNN using a classification report, a confusion matrix and comparing the validation accuracy to the training accuracy per epoch.

We should expect the validation accuracy and the training accuracy to be very similar for a better performing model. We want these accuracies to be as close to 1 as possible.

The confusion matrix and classification report will allow us to determine the precision, recall, F1 score and accuracy of the model. We want these values to be as high as possible (closer to 1). We want high accuracy because we want our model to determine parasitized cells efficiently. We want recall to be high as we want to reduce the number of False Negatives. Determine a patient to be Malaria Free even though they do actually have Malaria is not what we want. We want to reduce False Positives (maximize precision) as diagnosing someone who actually doesn't have Malaria will result in more time and costs when it comes to treatment, however the side effects from antimalarials are mild:

<https://patient.info/news-and-features/how-likely-are-side-effects-when-taking-malaria-tablets#:~:text=For%20instance%2C%20with%20Malarone%2C%20these,and%2010%25%20of%20patients.%22>

The overall F1 score should be as high as possible to take into account both precision and recall.